

# Section 2-4

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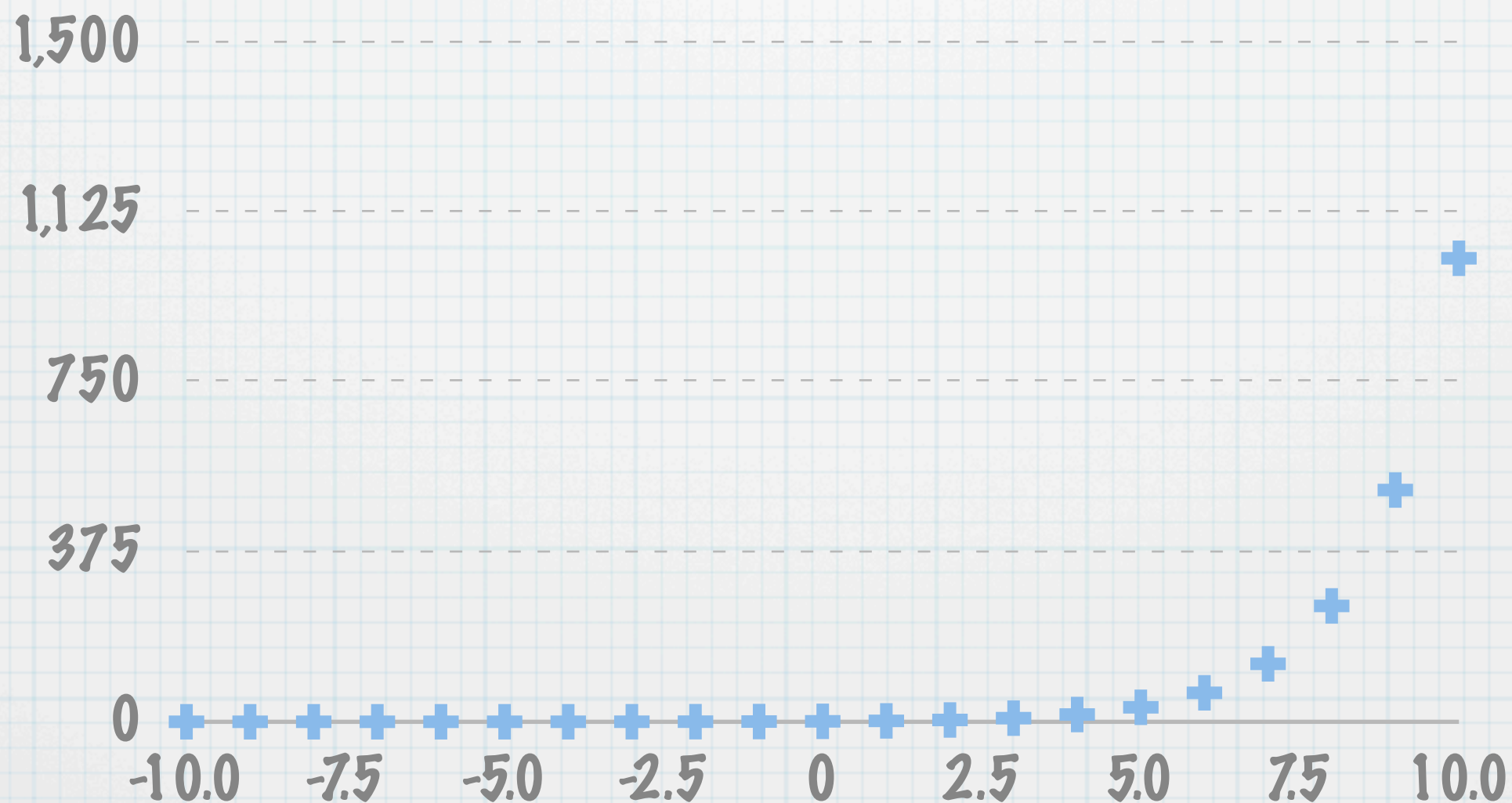
## Exponential Functions

# Warm-up

1. Calculate  $32^{n/5}$  for integer values of  $n$  from -10 to 10.
2. Use the results from question 1 for to calculate the results of  $32^{2.4}$ .
3. Which is largest, the 5<sup>th</sup> root of  $32^3$ , the 4<sup>th</sup> root of  $32^4$ , or the cube root of  $32^5$ ?

# Activity

On a separate piece of paper, graph the points you found in Question 1 of the warm-up. Connect the points and examine the graph. What characteristics do you notice?



## Exponential Function with Base b:

A function of the form  $f(x) = ab^x$ , where  $a \neq 0$ ,  $b > 0$ , and  $b \neq 1$

## Exponential Growth:

Occurs when  $b > 1$

This will lead to an increase in the situation

## Exponential Decay:

Occurs when  $0 < b < 1$

This will lead to a decrease in the situation



# Example 1

In 2318, the population of Mitarnowskivania is estimated to be 264,000,000 people and it will grow by 0.9% per year for many years to come.

a. Give a formula for the population of Mitarnowskivania for  $x$  years after 2318.

$$P = 264,000,000(1.009)^x$$

$P$  = population,  $x$  = years after 2318

b. From the formula, estimate the population in 2333.

$$P = 264,000,000(1.009)^{15} = 301,975,299 \text{ people}$$

c. Give a formula for the population for  $x$  years before 2318,  
and find the population in 2303.

$$P = 264,000,000(1.009)^x$$

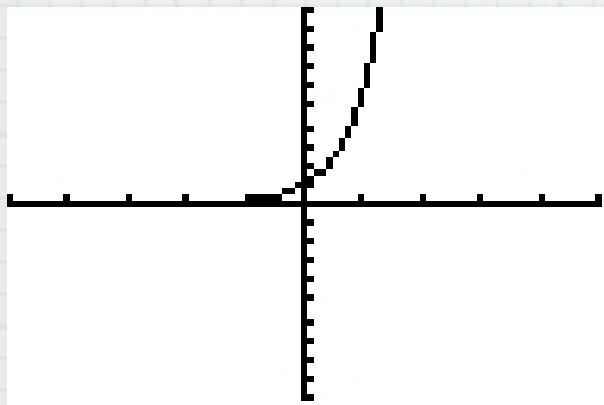
$P$  = population,  $x$  = years after 2318

$$P = 264,000,000(1.009)^{-15} = 230800334 \text{ people}$$

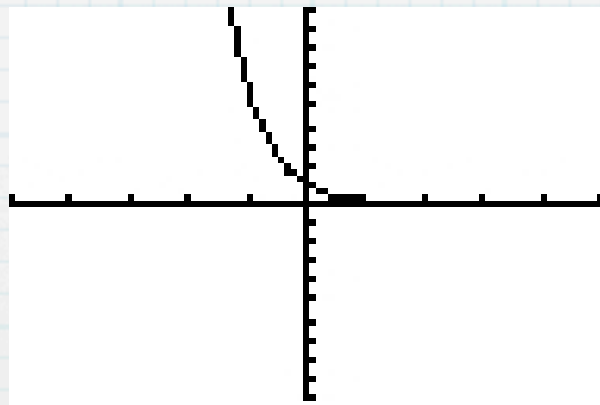
# Example 2

Compare and contrast the graphs of the three functions  $f$ ,  $g$ , and  $h$ :

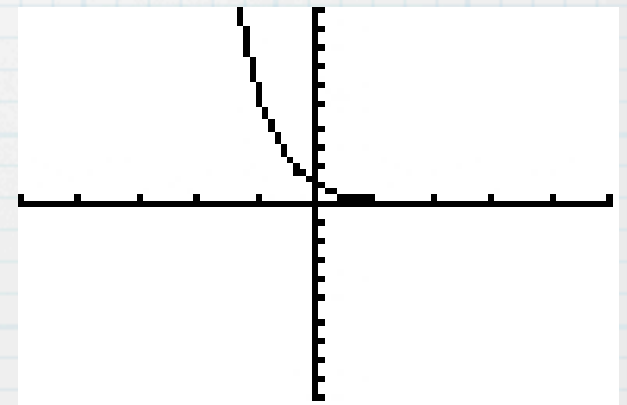
$$f(x) = 6^x$$



$$g(x) = \left(\frac{1}{6}\right)^x$$



$$h(x) = 6^{-x}$$





# Properties of Exponential Functions

- \* Domain: All real numbers
- \* Range: All positive real numbers (it'll never drop below the x-axis)
- \* Due to the range, we know that every positive real number can be written as a power



# Properties of Exponential Functions

- \* y-intercept: It will always be  $(0, a)$ , where  $a$  = the number in front of the growth factor
- \* x-axis: It doesn't intersect it at all! That means it's an asymptote!
- \* By the way, an asymptote is a line a graph approaches but never touches

# When $b > 1$ (Growth)

- \* The function is strictly increasing, meaning that when  $x$  gets bigger, so does  $f(x)$
- \* As  $x$  gets larger, there is no end to how high  $y$  gets!
- \* As  $x$  gets smaller, we get closer and closer to the asymptote, but we'll never reach it

# When $0 < b < 1$ (Decay)

- \* The function is strictly decreasing, meaning that when  $x$  gets bigger,  $f(x)$  gets smaller
- \* As  $x$  gets smaller, there is no end to how high  $y$  gets!
- \* As  $x$  gets larger, we get closer and closer to the asymptote, but we'll never reach it



# Homework

p. 109 # 1 - 21



